SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 28.—"On certain Ternary Alloys. I. Alloys of Lead, Tin, and Zinc." By C. R. Alder Wright, D.Sc., B.Sc., F.R.S., Lecturer on Chemistry and Physics, and C. Thompson, F.C.S., F.I.C., Demonstrator of Chemistry in St. Mary's Hospital Medical School.

It is well known, that quite apart from a tendency to separate more or less completely into different mixtures during solidification, certain mixtures of molten metals show a tendency to separate into two alloys of different densities on standing fused for some time. Lead and zinc and bismuth and zinc have been shown by Matthieson and V. Bose to form two such mixtures; the authors find that aluminium and zinc or aluminium and bismuth also behave in the same way; in each case two different alloys are formed, one consisting of the heavier metal with a little of the lighter one dissolved therein, the other of the lighter metal containing a small quantity of the heavier one.

On the other hand, *tin* will alloy indefinitely in all proportions with any of the four metals, lead, bismuth, zinc, or aluminium, the mixtures exhibiting no particular tendency to separate into two different alloys on simply remaining at rest in a fused condition, although in certain cases more or less separation is apt to occur *during solidification*, owing to partial formation of eutectic alloy. Various other metals, *e.g.* cadmium, antimony, silver, &c., appear to behave like tin in this respect.

It seemed to be of interest to examine the behaviour under similar conditions of ternary mixtures where two of the ingredients are not miscible together in all proportions (like aluminium and lead), whilst the third is miscible indefinitely with either of the other two (like tin). It might be expected that with certain proportions a single stable alloy would result, whilst with others the mass would divide into two different ternary mixtures. In point of fact this is precisely what occurs.

For a variety of reasons the authors selected the alloys of lead, tin, and zinc for their first experiments.

These led to the conclusion that the greater the proportion of tin present (provided it does not exceed the limiting amount beyond which no separation takes place) the more zinc is contained in the heavier alloy, and the more lead in the lighter one; but that the distribution of the tin throughout the entire mass is by no means uniform, the lighter alloy containing the greater percentage when the proportion of tin in the total mass is low, and *vice versâ* when it approaches towards the limiting amount; so that with a particular proportion of tin in the total mass uniform distribution as regards weight percentage occurs, but with no other proportion.

The authors next attempted to find out whether a moderately large variation in the temperature at which the mass kept molten had any great influence on the end result; for if not, obviously much laborious work would be saved. Two series of compound ingots (forty in all) were accordingly prepared, one at a temperature close to 565° C., the other at near to 689° C. From the analytical results obtained, three noteworthy curves are deducible—

(*a*) When the tin percentages in the heavier alloy are plotted as abscissæ and the zinc percentages as ordinates.

(*b*) When the tin percentages tin the lighter alloy are plotted as abscissæ and the lead percentages as ordinates.

(*c*) When the tin percentages in the heavier alloy are plotted as abscissæ and excesses of the percentage (+ or −) in the lighter alloy over those in the heavier one as ordinates.

These three curves respectively represent approximately the solubility of zinc in lead containing tin, that of lead in zinc containing tin, and the relative distribution of tin in the two alloys formed simultaneously. The three curves obtained from one series are practically identical with the corresponding curves from the other series, so that it may be fairly concluded that the effect of variation in temperature from 565° to 689° is negligible as compared with the experimental errors, more especially those due to imperfect separation by gravitation of the two alloys from one another.

The curves representing the tin distribution are remarkable. As long as the tin percentage in the total mass is less than about sixteen the lighter alloy contains more tin than the heavier one; at about this point (representing some 14 per cent. in the heavier and 18 per cent. in the lighter alloy) the difference becomes a maximum, after which the difference diminishes, until at about 28 per cent. the same percentage of tin is contained in both alloys. After this the heavier alloy contains more tin than the lighter, the difference continually increasing.

Certain irregularities were observed due to the existence of some cause interfering with the proper separation by gravitation of the heavier from the lighter alloy: this was ultimately traced to convection currents set up through unequal heating of the walls of the containing vessel at different levels, and it was found that the imperfect separation could be almost completely obviated by so heating the mass as to avoid this inequality of temperature. This was finally effected by employing crucibles very long in proportion to their diameter (large test-tubes moulded on a core from a plastic mixture of fireclay and syrupy silicate of soda, diluted with about three times its weight of water), heated by immersion in a bath of molten lead some 6 or 7 inches deep, contained in an iron cylindrical vessel (the lower two-thirds of a mercury bottle), surrounded by a concentric clay jacket and heated by a number of bunsen burners playing into the annular interspace. Several series of compound ingots were thus prepared, containing lead and zinc in ratios different for each series (2 to 1, 1 to 1, 1 to 2), some at a temperature near to 650°, others at about 750°. From the results of the analysis of upwards of 130 different alloys thus obtained, the following conclusions are drawn:—

When a mixture of lead, tin, and zinc in the molten condition is well stirred up by mechanical means and then left to itself for some hours at as nearly as possible a uniform temperature, a single homogeneous alloy results if the proportion of tin present is not less than three-eighths of the whole; but if materially less tin than this is present, the mass divides itself into two different ternary alloys, lead predominating in the heavier one and zinc in the lighter one. This phenomenon is entirely distinct from the segregation of alloys during solidification, in consequence of formation of eutectic or other differently fusible alloys.

If there is little or no inequality of temperature at different parts of the mass, separation by gravitation only is complete in a few hours, at any rate when tolerably pure metals are employed; but if the mode of heating is such that convection currents are set up, the separation is greatly interfered with, and in extreme cases almost entirely prevented.

The heavier alloy is a saturated solution of zinc in lead containing tin, and the lighter one a similar solution of lead in zinc containing tin. No matter what the relative proportions between lead and zinc in the original mass, the two alloys always correspond to two conjugate points on the solubility curves of zinc in lead-tin and of lead in zinc-tin.

But little, if any, difference in the way in which a given mass divides itself is noticeable, whether the temperature which the molten mass maintained is below 600° C. or above 700° C.

The tin contained in the mass does not distribute itself equally in the two alloys except when present in one particular proportion, which varies with the ratio of the zinc to the lead in the entire mass. With less tin than this the lighter alloy, and with more the heavier one, takes up the higher percentage of tin.

Curves drawn representing the tin present in the heavier alloy as abscissæ, and the (+ or −) excess of tin in the lighter alloy over that in the heavier one as ordinates, are found to differ with the ratio of zinc to lead in the entire mass. They always possess the same general features, viz. rising from the origin to a maximum elevation, then sinking down again to the base line, and crossing it so as to become negative; but the position and height of the maximum, the crossing point, and the general dimensions of the curve, vary with the ratio of zinc to lead in the mass.

As a result of this, whilst an indefinite number of different mixtures may be prepared, each one of which will give the same heavier alloy, the lighter alloy simultaneously formed will be different in each case; and conversely.

When no tin is present, lead dissolves zinc to such an extent as to form an alloy containing 1·24 per cent. of zinc, and zinc dissolves lead forming an alloy containing 1·14 per cent. of lead; the higher values found by previous observers being slightly incorrect through imperfect separation.

Nothing abnormal appears to characterize the solubility curves of zinc in lead-tin and of lead in zinc-tin; in each case the amount of one metal dissolved by the other increases as the quantity of tin present increases, in such a way that the curves are somewhat concave upwards.

Royal Society, April 4.—"On the Magnetic Inclination, Force, and Declination in the Caribee Islands, West Indies." By T. E. Thorpe, Ph.D., F.R.S.

The following determinations of the magnetic elements among the Caribees or Windward Islands were made in

August 1886, on the occasion of the Eclipse Expedition of that year to Grenada.

The instruments employed were magnetometer Elliott No. 61, and Dip Circle Dover 83, belonging to the Science and Art Department.

The method of observation was similar to that adopted in the Magnetic Survey of the British Isles for epoch January 1, 1886, for which these instruments were also employed.

The results may be thus summarized:—

Station: August 1886	Inclination	Force		Declination
		Horizontal	Total	
St. George, Grenada ...	40° 54′·7	3·1093	4·1144	0° 41′·5 E.
Hog Island, Grenada ...	41 14·1	3·1000	4·1223	0 51·5 E.
Island of Carriacou ...	—	3·0771	—	0 16·3 E.

Linnean Society, April 4.—Mr. Carruthers, F.R.S., President, in the chair.—Mr. D. Morris exhibited a specimen of the hymenopterous insect, *Eulema cayennensis*, concerned in the fertilization of *Coryanthes macrantha* (see Crüger, Journ. Linn. Soc., viii. 129), and obtained from Mr. Hart of Trinidad. Referring to the illustrations of the structure of the flowers, given in the *Gardener's Chronicle* (xvii., 1882, 593; and xxiii., 1885, 145), Mr. Morris explained the process carried out by the insects, chiefly bees, in removing the pollinia and subsequently attaching them on the stigma. The observations of Crüger had been verified by Mr. Hart in the Botanic Gardens, Trinidad.—Sir Edward Fry exhibited and made some instructive remarks on a copy of Grisley's "Viridarium Lusitanicum," 1661, presented by Linnæus to his pupil Loefling, the author of the "Iter Hispanicum."—Prof. R. J. Anderson exhibited some photographs of educational museum cases in Queen's College, Galway.—A paper was read by Mr. Lister on the Myxomycetes, or Mycetozoa, a group of organisms on the borderland between the animal and vegetable kingdoms, and formerly classed with Fungi. His remarks were illustrated by numerous coloured drawings of representative species, and the author also exhibited under the microscope the swarm cells from the spores of *Amaurochæte* and the streaming plasmodium of *Badhamia*. Attention was especially directed to the mode of feeding of the swarm cells and observations made on those of *Stemonitis*, where large bacilli were seen to be caught by pseudopodia projected from the posterior end of the organism, and drawn into its substance and digested. An interesting discussion followed, in which the President, Prof. Marshall Ward, Prof. Howes, and Mr. Breese took part.—A paper was then read by Mr. E. W. Hoyle, on the deep-water fauna of the Firth of Clyde, embodying the results of recent investigations. The explored area, which is shut off from the Irish Sea by a submarine plateau extending from the Mull of Cantyre to the Ayrshire coast, contains seven distinct deep-water basins, in which the depth exceeds 20 fathoms, and in some cases reaches 80 or 100 fathoms. An account was given of the dredging which had been carried on, with lists of the species obtained at various depths. A discussion followed in which Messrs. John Murray, W. P. Sladen, and G. B. Howes took part.

Chemical Society, March 21.—Mr. W. Crookes, F.R.S., in the chair.—The following papers were read:—The molecular weights of metals (preliminary notice), by Prof. W. Ramsay, F.R.S. The molecular weights of a number of metals have been determined by Raoult's vapour-pressure method, viz. by ascertaining the depression of the vapour-pressure of the solvent produced by a known weight of dissolved substance, the relation between molecular weight and depression being expressed by the equation, $W = \frac{W' \times P \times p}{100 \times d}$, where W is the molecular weight to be found; W′ the molecular weight of the solvent; P/100 the percentage weight of the dissolved substance in solution; *p* the vapour-pressure of the solution; and *d* the depression in the vapour-pressure of the solvent produced by adding the substance dissolved. The solvent employed was liquid mercury; the temperatures 260° and 270° for a few substances, and the boiling-point of mercury for most. The results obtained are as follows:—

Element.	Atomic weight.	Molecular weight.		Molecular formula.
		Found.	Calculated	
Lithium . . .	7·02	7·00	7·02	Li_1.
Sodium . . .	23·04	12·1	11·52	$Na_{\frac{1}{2}}$.
Potassium . .	39·14	28·57	?	K_1 (?).
Silver	107·93	109·0	107·93	Ag_1.
Gold	197·22	204·3	197·22	Au_1.
Barium . . .	137·0	74·45	68·5	$Ba_{\frac{1}{2}}$.
Magnesium . .	24·3	20·33	24·3	Mg_1.
Zinc	65·34	60·85	65·43	Zn_1.
Cadmium . .	112·1	100·0	112·1	Cd_1.
Gallium . . .	69·9	68·1	69·9	Ga_1.
Thallium . . .	204·2	183·5	204·2	Tl_1 (?).
Tin	119·1	114·9	119·1	Sn_1.
Lead	206·93	204·1	206·9	Pb_1.
Antimony . .	120·2	134·2	120·3	Sb_1.
Bismuth . . .	208·1	209·2	208·1	Bi_1.

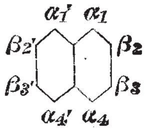
These numbers represent some of the actual results. Nevertheless, they must not be taken as absolute; although in many cases they are conclusive as to the molecular weight of the metal, still further experiments are needed. As an instance of what occurs, the metals thallium and antimony may be chosen. With thallium, for example, the following results were obtained:—

Percentage of thallium in amalgam.	Molecular weight.	
	Found.	Calculated.
0·8191	157·4	204·2
1·666	183·5	204·2
2·894	174·3	204·2
3·290	183·9	204·2

No appreciable change is produced on concentration. But with antimony, the molecular weight increases proportionately to the amount present, thus—

Percentage of antimony in amalgam.	Molecular weight.	
	Found.	Calculated.
1·117	134·2	120·3
1·526	155·4	120·3 to 240·6
2·257	193·4	120·3 to 240·6
3·289	294·6	240·6 to 481·2?

Here an association of atoms is evidently in progress. The results are based on the assumption that the molecular formula of mercury is Hg_1, in favour of which strong reasons can be adduced.—The application of Raoult's depression of melting-point method to alloys, by Messrs. C. T. Heycock and E. H. Neville. As a result of some preliminary experiments on the change in the solidifying point of tin caused by the addition of small quantities of other metals, the authors conclude that the dissolution of a metal in tin follows the same laws as that of compounds in other solvents, *i.e.* (1) that the fall in temperature of the solidifying point is directly proportional to the weight of metal added; and (2) that the fall of temperature is inversely as the atomic (molecular?) weight of the metal added. With tin, copper, silver, cadmium, lead, and mercury, the dissolution of one atomic proportion in 100 atomic proportions of tin caused a fall in temperature of the solidifying point varying from 2°·16 to 2°·67, with aluminium a fall of 1°·34, and with antimony a rise of 2°·0. In the discussion which followed the reading of these papers, Prof. Armstrong said that notwithstanding the apparent regularity and simplicity of the results, he was not prepared to accept them as in the least degree final. There was not sufficient evidence in his opinion that the effect observed was not in part at least the outcome of a change in the molecular composition of the solvent. The results obtained by Raoult's methods were, he thought, comparable with those obtained by determining the specific heats of the elements; in the latter case the observations were undoubtedly made with masses of molecules, which probably were of varying degrees of atomic complexity, and yet the results were found to be such as to justify conclusions being drawn as to the relative magnitudes of their fundamental constituents—the atoms. In the same way it was possible that the results obtained by Raoult's method by means of observations on the behaviour of molecular complexes might afford the means of deducing the relative magnitudes of the fundamental molecules comprising the complexes, but not of the actual complexes operated with. Mr. Crompton drew attention to Beckmann's recent experiments on the lowering of the freezing-point; these show that the true molecular weight was only obtained when solutions were used the concentration of which was allowed to vary only within certain narrow limits; and that if the solutions were too dilute the molecular weight obtained from the lowering of the freezing-point was too low, while if the solutions were too concentrated, it was too high. In some cases the variation of the number obtained with the concentration was enormous. Prof. Carey Foster remarked that much depended on the definition given of a molecule, whether it is defined as that smallest quantity capable of existence *per se*, or as that quantity which produces a given effect in depressing vapour-pressure, or freezing-point, &c. The two magnitudes were not necessarily the same. The relation observed could hardly be accidental; yet he thought that the value obtained might be a quantity connected with the molecular weight but not necessarily identical with it. Prof. Ramsay, in replying, said that substances in dilute solutions must be regarded as in the gaseous state, their molecules being so far distant from each other as not to exert appreciable attraction on each other; and as occupying but a small portion of the space they inhabit. It has long been argued that the molecular complexity of the gases, hydrogen, oxygen, and nitrogen, must be the same, inasmuch as these elements have equal coefficients of expansion within the widest limits of temperature. A similar argument applies to substances in dilute solutions; it is much more probable that they have a simple and similar molecular structure than that the molecules, if complex, dissociate to an equal extent on equal rise of temperature, or on equal alteration of concentration. As regards the empirical nature of Raoult's laws, it is paralleled by the empirical nature of Boyle's and Gay-Lussac's laws—that is, such laws are merely approximations to truth, and depend on the fact that the molecules are sensibly beyond the sphere of each other's attraction, and themselves occupy no appreciable space. Hence their inapplicability at high concentrations.—Some compounds of tribenzylphosphine oxide, by Dr. Collie.—Contributions to our knowledge of the isothiocyanates, by Dr. A. E. Dixon.—The constitution of primuline and allied sulphur-compounds, by Mr. A. G. Green.—The determination of the constitution of the heteronucleal αβ- and ββ-di-derivatives of naphthalene (second notice), by Prof. H. E. Armstrong and Mr. W. P. Wynne. Three heteronucleal α-chloro-β-naphthylaminesulphonic acids can be obtained when 1 : 2-α-chloro-β-naphthylamine hydrochloride is sulphonated with four times its weight of an acid containing 2 per cent. of SO_3. Acid No. I. is the chief product when the sulphonation is effected at 70° during six hours; acid No. II. is almost the sole product when the sulphonation is allowed to continue for a further six hours at 100°; and acid No. III. is obtained, together with acid No. II., when the sulphonation is effected at 160° during six hours. The determination of the constitution of the heteronucleal αβ- and ββ-di-derivatives of naphthalene is arrived at from a study of these acids in the following way. Adopting the conventional symbol for naphthalene, with the α- and β-positions indicated, and numbering the positions 1, 2, 3, 4, 1′, 2′, 3′, 4′, as shown—



it is obviously possible to determine the relative positions of the three radicles, Cl, NH_2, and SO_3H, in a heteronucleal chloronaphthylaminesulphonic acid by determining the relative positions of the three pairs of radicles, Cl and NH_2, Cl and SO_3H, and NH_2 and SO_3H, and on this result to base the absolute orientation of the radicles, provided that it can be shown how the radicles are situated in any one of the two pairs of hetero-di-derivatives obtainable from the tri-derivative. No absolute method, free from reproach, has yet been devised for determining the constitution of any known hetero di-derivative of naphthalene, but in the case of the hetero-αα-di-derivatives arguments may be advanced which are of such weight as to leave but little room for doubt that the αα-di-derivatives corresponding in constitution with ζ-dichloronaphthalene (m.p. = 83°) have the constitution 1 : 1′; the αα-di-derivatives corresponding in constitution with γ-dichloronaphthalene (m.p. = 107°) having then, by exclusion, the alternative formula 1 : 4′. The constitution of α-chloro-β-naphthylamine, and consequently the relative positions of the radicles Cl and NH_2 in the three sulphonic acids derived from it, was determined by the authors to be 1 : 2 (cf. NATURE, December 13, 1888, p. 166); the relative positions of the radicles Cl and SO_3H in the three acids were determined by replacing the NH_2 radicle by H by von Baeyer's hydrazine method, and converting the resulting heteronucleal chloronaphthalenesulphonic acids into the corresponding dichloronaphthalenes by treatment with phosphorus pentachloride, and the relative positions of the radicles NH_2 and SO_3H were ascertained by replacing the Cl by H by reduction with sodium amalgam, and converting the resulting heteronucleal naphthylaminesulphonic acids, first into the corresponding chloronaphthalenesulphonic acids by Sandmeyer's method, and finally into the corresponding dichloronaphthalenes. Acid No. I. yields, by displacing NH_2 by H, a chloronaphthalenesulphonic acid corresponding in constitution with γ-dichloronaphthalene, and therefore contains the radicles Cl and SO_3H in the positions 1 : 4′; it follows then, since the radicles Cl and NH_2 are in the positions 1 : 2, that the radicles NH_2 and SO_3H must be in the positions 2 : 4′. The naphthylaminesulphonic acid obtained from No. I. acid by reduction was found to be identical with Dahl's modification of β-naphthylamine-α-sulphonic acid, and to yield a dichloronaphthalene identical with so-called η-dichloronaphthalene (m.p. = 48°), so that these and all corresponding heteronucleal αβ-di-derivatives are proved to have the constitution 2 : 4′. Acid No. III., on displacing NH_2 by H, yields a chloronaphthalenesulphonic acid corresponding in constitution with the Badische modification of β-naphthylamine-α-sulphonic acid and with the heteronucleal αβ-dichloronaphthalene melting at 63°·5, and this must, by exclusion, be the 1 : 2′-compound, since the only alternative formula for a heteronucleal αβ-di-derivative, viz. 1 : 3′ or 2 : 4′, has been proved above to belong to αβ-di-derivatives corresponding in constitution with η-dichloronaphthalene (m.p. = 48°). Inasmuch, then, as acid No. III. contains the radicles Cl and SO_3H in the positions 1 : 2′, and the radicles Cl : NH_2 in the positions 1 : 2, it follows that the radicles NH_2 and SO_3H must be in the positions 2 : 2′. The naphthylaminesulphonic acid obtained from No. III. acid by reduction was found to be identical with Bayer and Duisberg's modification of β-naphthylamine-β-sulphonic acid, and to yield a dichloronaphthalene identical with δ-dichloronaphthalene (m.p. = 114°), so that these and all corresponding heteronucleal ββ-di-derivatives are proved to have the constitution 2 : 2′. Acid No. II., on displacing NH_2 by H, yields a chloronaphthalenesulphonic acid convertible into η-dichloronaphthalene; it follows, then, that it contains the radicles Cl and SO_3H in the positions 1 : 3′, and since the radicles Cl and NH_2 are in the positions 1 : 2, the radicles NH_2 and SO_3H must be in the positions 2 : 3′. The authors could not, however, succeed in isolating this naphthylaminesulphonic acid owing to the peculiar behaviour of acid No. II. on reduction with sodium amalgam, but they have been able by other methods to place it beyond doubt that the acid when isolated would be found identical with Brönner's β-naphthylamine-β-sulphonic acid, and would yield a dichloronaphthalene identical with ε-dichloronaphthalene (m.p. = 135°), hence these and all corresponding heteronucleal ββ-di-derivatives have the constitution 2 : 3′. These results not only render it possible to determine the constitution of the heteronucleal αβ- and ββ-di-derivatives of naphthalene, but also afford a method of ascertaining the constitution of the two heteronucleal sulphonic acids obtained on sulphonating 1 : 2 dichloronaphthalene, and of the three trichloronaphthalenes which have been obtained from the three chloronaphthylaminesulphonic acids; the method is being extended by the authors to all the known chloronaphthylamines for the purpose of determining the constitution of the sulphonic acids obtained by them in characterizing the corresponding dichloronaphthalenes. The results, moreover, establish the correctness of the opinion, long held and frequently expressed by the authors, based on the higher melting-points of the "uniform" ε-di-derivatives (*i.e.* di-derivatives containing two similar radicles) in comparison with the isomeric δ-di-derivatives, that the ε-di-derivatives are symmetrically constituted; this conclusion, in fact, is probably the most important outcome of the experiments, since it affords conclusive proof of the influence of symmetry as the determining cause of high melting-point, slight solubility, &c., in the case of naphthalene derivatives.—Contributions to the knowledge of citric and aconitic acids, by Mr. S. Skinner and Dr. S. Ruhemann.

Entomological Society, April 3.—Mr. F. Du Cane-Godman, F.R.S., Vice-President, in the chair.—Mr. Osbert Salvin, F.R.S., exhibited specimens of *Ornithoptera trojana*, Staud., and *O. plateni*, Staud., received from Dr. Staudinger, and obtained in Palawan, an island between Borneo and the Philippines. He remarked that *Ornithoptera trojana* was allied to *O. brookiana*, Wall.—Mr. R. McLachlan, F.R.S., exhibited, and made remarks on, seven examples of *Æschna borealis*, Zett., a little-known species of European Dragon-flies. He said that some of the specimens were captured by himself at Rannoch, in June 1865. The others were taken in Luleå, North Sweden, and the Upper Engadine (5000–6000 feet), in Switzerland.—Mr. W. H. B. Fletcher exhibited specimens of *Agrotis pyrophila* from various localities, including two from Portland, three from Forres of a smaller and darker form, and a melanic specimen from Stornoway at first supposed to belong to *A. lucernea*, but which, on closer examination, was seen to be referable to this species. He also exhibited series of *Triphæna orbona* from Stornoway and Forres, and *T. subsequa* from Forres and the New Forest. The specimens of *T. subsequa* from Forres were more distinctly and richly marked than those from the New Forest, and were also rather more variable in colour.—Dr. Sharp exhibited specimens of *Proculus goryi*, Kaup, found by Mr. Champion in Guatemala, prepared to show the rudimentary wings under the soldered elytra. Dr. Sharp called attention to the existence of a peculiar articulated papilla at the base of one of the mandibles; and he also showed sections of the head of *Neleus interruptus* displaying this papilla, as well as the articulated teeth on the mandibles.—The Rev. Canon Fowler exhibited specimens of *Agapanthia lineatocollis*, Don, and remarked that they were able to produce a distinct stridulation by the movement of the head against the prothorax, and of the hinder part of the prothorax against the mesothorax. He further remarked that Dr. Chapman had lately informed him that *Erirrhinus maculatus*, F., had the power of stridulating strongly developed.—Mr. Edward Saunders exhibited, on behalf of Mr. G. A. J. Rothney, in illustration of his paper on Indian Ants, specimens of the following:—*Camponotus compressus* and fragments of *Solenopsis geminatus* destroyed by it; *Camponotus* sp. (?), with a mimicking spider (*Salticus* sp.); *Pseudomyrma bicolor*, with its mimicking *Salticus*, and a new species of *Rhinopsis*, viz. *ruficornis*, Cameron, also found with it, and closely resembling its host; *Diacamma vagans*; *Holcomyrmex indicus*, with specimens of the grain which it stores and the chaff which it rejects; and a species of *Aphænogaster*, with the pieces of *Mimosa* with which it covers its nest.—Mr. G. A. J. Rothney communicated a paper entitled "Notes on Indian Ants."—Mr. Lionel de Nicéville communicated a paper entitled "Notes regarding *Delias sanaca*, Moore, a Western Himalayan Butterfly."—Captain H. J. Elwes communicated a note in support of the views expressed by Mr. de Nicéville in his paper.

Geological Society, April 3.—Mr. W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—The elvans and volcanic rocks of Dartmoor, by Mr. R. N. Worth.—The basals of Eugeniacrinidæ, by Mr. F. A. Bather. Although Profs. Beyrich and von Zittel had alluded to certain specimens of *Eugeniacrinus* as proving, by the course of the axial canals, that in this genus the basals had passed up into the radials, yet the two chief authorities who subsequently discussed the subject practically ignored this argument. M. de Loriol contented himself with denying any trace of basals, while Dr. P. H. Carpenter maintained that the top stem-joint represented a fused basal ring. In a previous paper the author had argued in favour of Prof. von Zittel's view without convincing Dr. Carpenter of its correctness. Such scepticism was, no doubt, warranted by the lack of detailed description and of figures. The object of the present note was to set the matter at rest by describing and figuring certain dorsal cups of *Eugeniacrinus caryophyllatus* kindly lent to the author by Prof. von Zittel. Owing to the mode of fossilization the canal system is plainly seen. The axial canal passes up into the radial circlet and gradually widens; at a short distance below the floor of the calycal cavity it gives off five interradial branches; these soon bifurcate, and the adjacent radial branches converge. Before they meet, each radial branch gives off a very short branch; this connects the radial branch with the ring-canal that contained the interradial and intraradial commissures. The evidence of all other crinoids that have these canals shows that the basals always contain the interradial branches. And in *Eugeniacrinus*, since the interradial branches have their origin in the middle of the radials, the basals must have passed up in between the radials. The President, Mr. P. Sladen, and Dr. Hinde took part in the discussion which followed the reading of this paper.—On some Polyzoa from the Inferior Oolite of Shipton Gorge, Dorset, by Mr. E. A. Walford.

Mathematical Society, April 11.—Mr. J. J. Walker, F.R.S., President, in the chair.—The Secretary read the following papers:—On the free vibrations of an infinite plate of homogeneous isotropic elastic matter, by Lord Rayleigh, F.R.S.—On the constant factors of the theta series in the general case $p = 3$, by Prof. F. Klein.—On the generalized equations of elasticity and their application to the theory of light, by Prof. K. Pearson.—On the reduction of a complex quadratic surd to a periodic continued fraction, by Prof. G. B. Mathews.—Construction du centre de courbure de la développée de contour apparent d'une surface que l'on projette orthogonalement sur un plan, by Prof. Mannheim.—Mr. Kempe and the President made short communications.

Berlin.

Physical Society, March 22.—Prof. du Bois-Reymond, President, in the chair.—Dr. Assmann gave an account of the results he had obtained by a microscopic examination of the structure of rime, hoar-frost, and snow. In opposition to the view most usually held, that the solid condensations of aqueous vapour from the air are crystalline, he had observed some years ago, during a sojourn in winter on the Brocken, that hoar-frost consists of amorphous frozen drops, which, by their juxtaposition in rows, build up the long needles of which it is composed. He observed the same structure in some rime which he had collected from very various objects in December last during a cold which was not at all intense; in this case also the spicules of ice were composed of amorphous drops of ice frozen together in lines. In one case the little masses of ice which composed the rime were frozen together into a leaf-like structure. At the same time some small, scattered, and glittering ice-formations which had been formed in large numbers on the ground were crystalline in structure, consisting of thicker or thinner six-sided tablets or somewhat elongated prisms. On other occasions he found that the rime was itself composed of unequally developed crystalline structures, which branched at angles of 60°, and thus gave rise to a dendritic formation; at the same time the hoar-frost was also composed of crystalline structures. He had also succeeded in forming ice-flowers artificially on a pane of glass, and had satisfied himself by a microscopic examination of the same that they are always crystalline in structure. The structure of snow was investigated on the snow garlands which had been described at a meeting of the Meteorological Society, and consisted of amorphous granules, such as compose the upper surface of a glacier. Dr. Assmann attributes the formation of rime and of hoar-frost to the existence of over-cooled drops of water, which suddenly solidify when driven by the wind against the solid substructure on which they are found. On the other hand, solid transparent ice is formed when water at 0°, or some temperature above zero, comes in contact with any solid object whose temperature is very low.—Prof. Liebreich exhibited a series of experiments intended to explain the occurrence of the inert layer in chemical reactions. Two years ago he had demonstrated to the Society the chief phenomena of its occurrence, as seen when a solution of sodium carbonate is mixed with chloralhydrate. When this is done the larger part of the mixed fluids very soon becomes milky, owing to the formation of innumerable small drops of chloroform, while at the same time a thin layer on the surface of the fluid remains clear: this clear portion is the inert layer, and is bounded above by the general meniscus of the mixture and below by a curved surface, whose convexity is turned upwards towards this meniscus. The speaker had, by means of a series of experiments, disposed of the view which had been put forward that the inert layer is only a portion of the mixed fluids from which the chloroform had evaporated. Of these experiments it may suffice to mention only one, in which the fluid was poured into a flat, open basin until it projected with a convex surface above the edges of the basin. Notwithstanding the larger fluid-surface thus exposed no inert layer was to be seen. Similarly he had been able to show, by observations under the microscope, that the phenomenon cannot be explained by any vortex movements in the fluid. Further, the assumption that it is due to a solution of alkali from the glass, which then prevents the precipitation of the chloroform, had been excluded by using a vessel made of quartz crystal. Prof. Liebreich inclined to the view, on the basis of his past experiments, which, however, must be further followed and extended, that the suppression or slowing of the chemical reaction at the surface of the fluid, which gives rise to the inert layer, is determined by the greater solidity and resistance of this part of the liquid.

Meteorological Society, April 2.—Prof. von Bezold, President, in the chair.—Prof. Börnstein spoke on the ebb and flow of the tide. After explaining the nature of the moon's action on the fluid part of the earth's surface, and showing that the flood is essentially due to a diminution of gravity and the ebb to its increase, he passed on to the consideration of the moon's attraction as it affects the atmosphere. Many experiments have been made with a view to proving the influence of the moon on the atmosphere, and at various places observers have succeeded in establishing a daily variation in the pressure of the air dependent upon the moon, and showing two maxima and two minima; these places are Singapore, St. Helena, Melbourne, and Batavia. The amplitude of the variation amounted to from 0·079 to 0·2 mm. But opposed to these are the observations of Laplace on the variations of the barometer in Paris, as also of Kreil in Prague, and further, Bessel's observations on atmospheric refraction. All these last-named observers found that the action of the moon on the earth's atmospheric envelope was either *nil* or else the reverse of that described above. Prof. Börnstein then discussed the question whether any ebb and flow of the atmosphere could possibly be detected with the means now at our disposal, and showed that the mercurial barometer can never be able to give indications of any such action, since it is itself affected by the alterations of gravity which are due to the varying position of the moon. He explained the phenomena observed at the four stations mentioned above as due to the fact that they are situated either on the sea-coast or on islands, at places on the earth's surface at which the ebb and flow of the sea is very considerable. The ebb and flow of the sea acts secondarily on atmospheric pressure, especially by means of the alteration of surface, and give rise to corresponding increases and diminutions in that pressure. Paris, Prague, and Königsberg are, on the other hand, inland stations, at which the barometer cannot be affected by any variations in the level of the sea's surface.

STOCKHOLM.

Royal Academy of Sciences, March 14.—On the essential results of the mathematical paper for which M. Poincaré received the mathematical prize of the King of Sweden, by Prof. Mittag-Leffler.—Derivation of some independent expressions of the Bernouillian numbers, by Dr. A. Berger.—On the plane curves which may be rectified through Abel's integrals of the first kind, by Dr. J. Brodén.—On the conform delineation of a paraboloid on a plane, by Herr H. von Koch.—On some remarkable minerals formed at a later period in the primordial strata of Sweden, by Baron Nordenskiöld.—Sur la chaleur latente de vaporisation de l'eau et la chaleur spécifique de l'eau liquide, par Dr. N. Ekholm.—New observations on the variation of the shape of the first abdominal appendices of the female crawfish, by Dr. Bergendahl.—Contributions to the anatomy of the Trematode genus *Apoblema Dujardin*, by Herr H. Juel.—Ascomycetæ from the Isle of Öland and from Östergötland, by Herr C. Starbäck.—On some triazol derivatives, by Dr. J. A. Bladin.—On bisphenyl-methyl-triazol, by the same author.—On the molecular weight of maltose and some inulinoid carbohydrates, by Dr. Ekstrand and Herr R. Manzelius.—Annotations on some European Orthotricha, i., by Lector Grönvall.—Déterminations des éléments magnétiques dans la Suède méridionale, by Herr W. Carlheim-Gyllenskiöld.—Formulas and tables for calculation of the absolute perturbations of the planets, by Herr Masal.

AMSTERDAM.

Royal Academy of Sciences, March 30.—Dr. Van den Sanden in the chair.—M. Forster stated the results of some experiments made in his laboratory, by Mr. Hunder Stuart and Mr. Fraser Ewman, on the presence of bacteria in the intestines. Mr. Stuart found that ordinary, and Mr. Ewman that typhoid, bacteria, introduced into the stomach along with the food, are discovered later only in the lowest part of the smaller intestine, and further in the large intestine. Ordinary bacteria have, therefore, no influence on the digestive process.—By means of known properties of polar systems and of elementary reasoning about reality, M. Schoute proved geometrically that the co-variant of Hesse, belonging to a binary equation with real co-efficients, is negative for the values of the variable that correspond to the real roots of the equation, independently of the number of its real roots; this is an extension of Dr. F. Gerbaldi's theorem (compare *Rendiconti di Palermo*, tome iii. p. 22).—M. J. A. C. Oudemans read a paper on the present state of the methods for determining the parallaxes of fixed stars.

VIENNA.

Imperial Academy of Sciences, February 21.—The following papers were read:—On the specific brightness of colours, a contribution to the physiology of visual sensations, by F. Hillebrand.—On the law of the decreasing of the power of absorption at increasing thickness of absorbent layers, by W. Müller-Erzbach.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

E. Museo Lundii, Part 1 (Copenhagen, Hagerups).—The Bacteria in Asiatic Cholera: E. Klein (Macmillan).—Systematic Account of the Geology of Tasmania: R. M. Johnston (Tasmania).—Life; what it is sustained by, and Cognate Subjects: W. Boggett (Trübner).—Proceedings of the London Mathematical Society, vol. xix. (Hodgson).—Flora Orientalis, Supplementum: R. Buser (Geneva, Georg).—Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung, 1888 (Magdeburg).—Wild Life in a Southern County: new ed., R. Jefferies (Smith, Elder).—The Structure and Distribution of Coral Reefs, 3rd edition, with an Appendix by Prof. Bonney: C. Darwin (Smith, Elder).—Statics for Beginners: J. Greaves (Macmillan).—The Anatomy of Astrangia danæ, six lithographs from drawings by A. Sonrel; explanation of plates by J. W. Fewkes (Washington).—New Zealand Meteorological Report, 1885 (Wellington).—Proceedings of the Geologists' Association, February (Stanford).—Journal of the Institution of Electrical Engineers, No. 78 (Spon).—Quarterly Journal of Microscopical Science, April (Churchill).—Brain, No. 44 (Macmillan).—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Zehnter Band, v. Heft, Elfter Band, i. Heft (Leipzig, Engelmann).—Bulletin of the American Geographical Society, vol. xxi. No. 1 (N.Y.).—Bulletin from the Laboratories of Natural History of the State University of Iowa, vol. i. No. 1 (Iowa).—Journal of the Royal Statistical Society, March (Stanford).—Journal of the Royal Microscopical Society, April (Williams and Norgate).

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